Mobile radio receiver with integrated broadcast receiver

The invention relates to an apparatus for mobile communication, for example a mobile radio receiver with an integrated broadcast receiver.

For example, DE 41 41 382 A1 describes a cordless added-feature telephone provided with several additional functions, such as a computer, a dictation apparatus, a remote control and a broadcast and/or television receiver. The elements provided for telephone functions, for example the digit pad, function keys and notably the power supply should be shared by the telephone and the integrated additional functions.

The common use of other parts of an apparatus for mobile communication, for example keys, displays and power supply, has thus far been unsuccessful in mobile communication apparatus because for full availability the apparatus for mobile communication must receive control information also when it is not in use.

It is an object of the invention to enable common use of circuit elements of terminals of mobile communication for the reception of broadcast signals.

This object is achieved in that at least one component of the receiving section is arranged to receive broadcast signals, steps being taken so as to mask the gaps occurring in the broadcast reception at times wen control information is received for the mobile communication.

The advantage resides in the fact that components of the mobile radio telephone receiver can now also be used for broadcast reception, without the gap arising upon reception of control information being noticed by a listener. It is notably when a digital signal processor (usually present any away) is used to mask the gap in the broadcast signal that the additional space required for the function of the broadcast receiver is smaller than if the broadcast receiving section and the receiving section of the mobile radio telephone receiver were integrated adjacent one another.

The invention will be described in detail hereinafter with reference to the embodiments shown in the drawings.

Therein:

Fig. 1 shows a circuit diagram of a receiver according to the invention,

Fig. 2 shows a first embodiment in which only given circuit elements of a receiving stage are used in common for mobile radio reception and broadcast reception, and

Fig. 3 shows a second embodiment in which an integrated receiving stage is fully used for the reception of mobile radio signals and broadcast signals.

Fig. 1 shows the basic concept of a receiver according to the invention. As many components as possible of a receiving section 1 are used in common for the reception of the mobile radio channels as well as a radio station; further processing takes place by an audio stage 2 and a digital signal processor 3 for reproduction via a loudspeaker 4 or a headset. During the broadcast reception a control device 5 switches over the receiving section to the reception to the reception of the control channels in the mobile radio bands at the prescribed instants. During this time the digital signal processor 3 generates a substitute signal which masks the receiving gap in the broadcast band which is caused by the reception of the control information. For example, to this end the digital signal processor simply repeats a sequence received in the broadcast band prior to the switching-over, for example, the last 20 ms of an audio signal received.

Fig. 2 shows a feasible embodiment of a receiving section 1 of a multi-band radio apparatus for GSM, DCS 1800 and broadcast signals in the VHF band. Most components of the receiving section are contained in an integrated circuit IC. Because the transmission section is not used by the broadcast receiver, and hence does not form part of the invention, it has been omitted for the sake of clarity. Other components which are well known to a person skilled in the art, for example the keyboard, display elements and the power supply which are used in known manner for the mobile radio reception as well as for the broadcast reception have also been omitted for this reason.

A first antenna 6 and a first pre-filter 7 are arranged to receive the DCS 1800 band while a second antenna 8 and a second pre-filter 9 are arranged to receive the GSM band and a third antenna 10 and a third pre-filter 11 are arranged for VHF broadcast

reception. The individual receiving signals are applied to separate mixing stages 15, 16, 17 via separate pre-amplifiers 12, 13, 14. The mixing frequency, however, is generated in a single oscillator 18, which utilizes a PLL circuit and is common to all mixing stages and hence to all frequency bands. The PLL circuit in the present embodiment consists of a quartz oscillator 19, a quartz crystal which is externally connected to the integrated circuit IC, an automatic frequency control unit 21, a lock-in detector 22, a sequential switching element 23, a pre-counter 24, a programmable counter 25, a phase detector 26, a charge pump 27, a shift register 28, a station memory 29 and a low-pass filter 30 which is externally connected to the IC.

The receiving concept chosen for the present embodiment is a near-zero intermediate frequency concept which utilizes a low intermediate frequency, for example, 100 kHz, in comparison with the receiving frequencies. The frequency band received each time is applied to a first automatic gain control 31 and subsequently traverses a poly-phase near-zero intermediate frequency filter 32. Subsequently, the receiving signals of GSM and DCS 1800 are further processed in a second automatic gain controller 33, a buffer amplifier 34 and an analog-to-digital converter 35 whereas a parallel processing branch with a third automatic gain controller 37 and a poly-phase FM detector 38 is provided for the broadcast signals.

Generally speaking, for the concept according to the invention a compromise must be found between the common use of individual circuit elements of the receiving section for the reception of mobile radio bands and broadcast bands on the one hand and the expenditure so as to enable the common use of such circuit elements on the other hand. In the foregoing embodiment the expenditure is increased merely in the common PLL circuit, for example, because the frequency in the case of broadcast transmitters is not as stable as that in mobile radio transmitters and hence the receiving frequency must be readjusted for the fluctuating transmission frequency of the broadcast transmitters.

In the second embodiment, however, an integrated circuit (the Philips circuit OM5178 in the present embodiment) is fully used, without modifications, also for the reception of the broadcast signal bands. It is merely because of the different receiving frequencies of mobile radio bands and broadcast bands that the PLL requires a lower reference clock. According to this concept of the invention GSM receiving signals and broadcast receiving signals are received via separate antennas 40, 42 and separate pre-filters 41, 43 so as to be applied, via a first switch 45 and a first balun 46, to the high-frequency signal input of the integrated circuit IC. Furthermore, for the GSM band and the broadcast

band there are provided separate, external, controllable oscillators 47, 48 which receive, via an external PLL filter 49, the respective control signal of the PLL switching circuit included in the integrated circuit IC. The output signal of the relevant controllable oscillator is selected by means of a second switch 50 so as to be applied to the integrated circuit via a second balun 51. Moreover, use is made of an external oscillator 52 whose output signal is applied, because of the necessary lower reference frequency for the broadcast band, via a frequency divider 53 which is adjustable by the digital signal processor DSP. All specific functions for the broadcast reception such as, for example stereo detection as well as the detection of other functions contained in the broadcast signal, such as RDS (Radio Data Signal), are then executed completely in the digital signal processor DSP or in the Baseband Audio Interface BAI. For example, the AFC signal for readjusting the receiving frequency for broadcasts to the fluctuations of the broadcast transmitter are generated in the baseband audio interface BAI and applied to a second control input of the controllable oscillator 48 which is used for adjusting the broadcast receiving frequency.

The frequency bands GSM and DCS 1800, of course, are given merely by way of example. The invention can be used equally well for other receiving bands in as far as control information must be received from time to time in a standby state.